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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
WANG, BEN C	

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2192	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/772,555	SMITH ET AL.	
	Examiner	Art Unit	
	BEN C. WANG	2192	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10 July 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-23* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-23* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. Claims 1-23 are pending in this application and presented for examination.

2. Applicant's amendment dated July 10, 2008, responding to the Office Action mailed April 10, 2008 provided in the rejection of claims 1-23, wherein claims 1-2 and 14 have been amended.

Claims 1-23 remain pending in the application and which have been fully considered by the examiner.

Applicant provides no further arguments with respect to claims rejection.

Declaration of Ashutosh S. Dhodapka under 37 C.F.R. § 1.131

3. The amendment filed on July 10, 2008 under 37 CFR 1.131 is sufficient to overcome the *Calder* reference.

4. A new ground of rejection is applied for this pending application – see *Jacobson et al.* - art made of record, as applied hereto.

Claim Rejections – 35 USC § 102(b)

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102(b) that form the basis for the rejections under this section made in this office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 1-23 are rejected under 35 U.S.C. 102(b) as being anticipated by Quinn Able Jacobson (*High-Performance Frontends for Trace Processors, 1999, University of Wisconsin - Madison*) (hereinafter 'Jacobson' - art made of record)

6. **As to claim 1** (Currently Amended), Jacobson discloses an apparatus comprising:

- a processing unit of a processor;
- a memory coupled to the processor; and
- an instruction set operable on the processing unit of the processor and including instruction;
- to instantiate a data structure to collect a representation of a working set (e.g., P. 168, Fig. 5-3 Example global history branch predictor, elements of 'Table of 2-bit counters'; 'Current Branch PC'; P. 167, last Para - … built around <u>a table of 2-bit counters</u> …; P. 165, Sec. 5.2.1.1, Lines 8-14; Sec. 5.3.1 - Corrected Predictor; Sec. 5.3.2 – Hybrid Predictor); and

- defining a hash unit operable on the processing unit to map a plurality of working set elements into the data structure using a hash function (e.g., P. 168, Fig. 5-3 Example global history branch predictor, element of ‘Hash Funct’; Fig. 5-5 – Hashing Function; P. 170, last Para - ... The hashing function combines the trace starting address and branch outcomes into a condensed encoding (see Fig. 5-5))

7. **As to claim 2** (Currently Amended) (incorporating the rejection in claim 1), Jacobson discloses the apparatus wherein the data structure is a 2^n x m bit table, where n is a number of bit table entries and m is a width of the bit table (e.g., P. 168, Fig. 5-3 Example global history branch predictor, element of ‘Table of 2-bit counters’)

8. **As to claim 3** (Original) (incorporating the rejection in claim 2), Jacobson discloses the apparatus wherein m is in the range of 1 to 64 (e.g., P. 64, Lines 1-4 - ... an aggregate instruction window size of 64 instructions ...)

9. **As to claim 4** (Original) (incorporating the rejection in claim 2), Jacobson discloses the apparatus wherein m = 1 (e.g., P. 168, Fig. 5-3 Example global history branch predictor, element of ‘Table of 2-bit counters’)

10. **As to claim 5** (Original) (incorporating the rejection in claim 2), Jacobson discloses the apparatus wherein n is in the range of 1 to 20 (e.g., P. 168, Fig. 5-3 Example global history branch predictor, element of ‘Table of 2-bit counters’)

11. **As to claim 6** (Original) (incorporating the rejection in claim 1), Jacobson discloses the apparatus wherein the data structure is a 2^n-bit vector (e.g., P. 168, Fig. 5-3 Example global history branch predictor, element of ‘Table of 2-bit counters’)

12. **As to claim 7** (Original) (incorporating the rejection in claim 6), Jacobson discloses the apparatus wherein n = 1 (e.g., P. 168, Fig. 5-3 Example global history branch predictor, element of ‘Table of 2-bit counters’)

13. **As to claim 8** (Original), Jacobson discloses a computerized method of creating a representation of a working set, the computerized method comprising:

- mapping a plurality of working set elements into fields of a data structure using a hash function (e.g., P. 168, Fig. 5-3 Example global history branch predictor, elements of ‘Table of 2-bit counters’; ‘Current Branch PC’; P. 167, last Para - … built around <u>a table of 2-bit counters</u> …; P. 165, Sec. 5.2.1.1, Lines 8-14; Sec. 5.3.1 - Corrected Predictor; Sec. 5.3.2 – Hybrid Predictor; P. 168, Fig. 5-3 Example global history branch predictor, element of ‘Hash Funct’; Fig. 5-5 – Hashing Function; P. 170, last Para - ... The <u>hashing function</u> combines the trace starting address and branch outcomes into a condensed encoding (see Fig. 5-5))

14. **As to claim 9** (Original) (incorporating the rejection in claim 8), Jacobson discloses the computerized method wherein the mapping is performed for a fixed

interval of program execution (e.g., P. 93, 3rd Para - … periodically interrupted and all the dynamic structures (caches and predictors) are flushed …)

15. **As to claim 10** (Original) (incorporating the rejection in claim 9), Jacobson discloses the computerized method wherein the data structure is reset prior to each fixed interval of program execution (e.g., P. 60, Lines 1-2 – … the entire buffer can be cleared by simply resetting the pointer to the head of the buffer)

16. **As to claim 11** (Original) (incorporating the rejection in claim 10), Jacobson discloses the computerized method further comprising saving the fields of the data structure prior to resetting the data structure (e.g., P. 10, Lines 3-4 – by saving path history information …)

17. **As to claim 12** (Original), Jacobson discloses a computerized method of creating a representation of a working set, the computerized method comprising:

- executing a program for a fixed interval, the program comprising instructions identified by a program counter (e.g., P. 168, Fig. 5-3 - Example global history branch predictor, elements of 'Table of 2-bit counters'; 'Current Branch PC');
- performing a hash function on the program counter to create a hash value for each instruction executed during the fixed interval (e.g., P. 168, Fig. 5-3 Example global history branch predictor, element of 'Hash Funct'; Fig. 5-5 – Hashing

Function; P. 170, last Para - ... The hashing function combines the trace starting address and branch outcomes into a condensed encoding (see Fig. 5-5)); and

- updating a field of a table indexed by the hash value wherein the table represents the working set (e.g., P. 168, Fig. 5-3 Example global history branch predictor, elements of ‘Table of 2-bit counters’; ‘Current Branch PC’; P. 167, last Para - … built around a table of 2-bit counters …; P. 171, 2nd full Para through 1st Para - … The index generation mechanism uses a few bits from ….)

18. **As to claim 13** (Original), Jacobson discloses a computer system comprising:

- a bus;
- a memory coupled to the bus; and
- a processor coupled to tile memory and the bus; the processor comprising:
  - a data structure to collect a representation of a working set (e.g., P. 168, Fig. 5-3 - Example global history branch predictor, elements of ‘Table of 2-bit counters’; ‘Current Branch PC’; P. 167, last Para - … built around a table of 2-bit counters …; P. 165, Sec. 5.2.1.1, Lines 8-14; Sec. 5.3.1 - Corrected Predictor; Sec. 5.3.2 – Hybrid Predictor); and
  - a hash unit to map a plurality of working set elements into the data structure using a hash function (e.g., P. 168, Fig. 5-3 Example global history branch predictor, element of ‘Hash Funct’; Fig. 5-5 – Hashing Function; P. 170, last Para - ... The hashing function combines the trace

starting address and branch outcomes into a condensed encoding (see Fig. 5-5))

19. **As to claim 14** (Currently Amended) (incorporating the rejection in claim 13), Jacobson discloses the computer system further comprising:

- an instruction retirement unit; and
- wherein the data structure and the hash unit are part of an instruction retirement unit (e.g., Fig. 1-1 – Typical processor organization, element of 'Instruction Retirement Pipeline'; P. 3, 1st full Para)

20. **As to claim 15** (Original), Jacobson discloses a computerized method of estimating size of a working set, the method comprising:

- Receiving a signature for a working set (e.g., P. 168, Fig. 5-3 - Example global history branch predictor, elements of 'Table of 2-bit counters'; 'Current Branch PC'; P. 167, last Para - … built around <u>a table of 2-bit counters</u> …); and
- Estimating the size of the working set based on the size of the signature (e.g., P. 53, 1st Para - … with trace pre-construction based on dynamic learning … working set size ...)

21. **As to claim 16** (Original) (incorporating the rejection in claim 15), Jacobson does not disclose the computerized method wherein the estimating is performed with the following function:

K $$K = \log(1-f) \Big/ \log\left(1 - \frac{1}{2^n}\right),$$

wherein K is the number of unique working set elements, 2^n is the number of entries in the signature, and f is the fraction of 1 's in the signature.

However, it is well known in the art of mathematical prediction equations to incorporate a logarithm of the probability of transitioning multipliers into equations in order to obtain the benefits know in the art.

22. **As to claim 17** (Original), Jacobson discloses a computerized method of detecting working set changes, the method comprising:

- comparing a current working set signature to a previous working set signature (e.g., P. 16, 2nd Para - … predict the outcome of branches based on previous branch be $K = \log(1-f) \Big/ \log\left(1 - \frac{1}{2^n}\right),$ … containing two-bit saturating counter ..
- calculating a relative signature distance between the current working set signature and the previous working set signature (e.g., P. 61, 2nd Para - … along with each instruction is kept its minimal distance from the first instruction of the region … by looking at the minimal distance of a trace start point and the lowest minimal distance on the worklist … to make a conservative decision ...); and
- identify a working set change when the relative signature distance exceeds a predetermined threshold (e.g., P. 16, 2nd Para - … If the counter's value is above some threshold the branch is predicted taken …)

23. **As to claim 18** (Original) (incorporating the rejection in claim 17), Jacobson discloses the computerized method wherein the working set change indicates a phase change in a program (e.g., P. 168, Fig. 5-3 Example global history branch predictor, elements of 'Table of 2-bit counters'; 'Current Branch PC'; P. 167, last Para - … built around a table of 2-bit counters …; P. 165, Sec. 5.2.1.1, Lines 8-14; Sec. 5.3.1 - Corrected Predictor; Sec. 5.3.2 – Hybrid Predictor)

24. **As to claim 19** (Original), Jacobson discloses a computerized method of identifying a recurring working set, the method comprising:

- comparing a current working set signature to one or more previous working set signatures (e.g., P. 16, 2nd Para - … predict the outcome of branches based on previous branch behavior … a Pattern History Table … containing two-bit saturating counter …);
- calculating a relative signature distance between the current working set signature and the one or more previous working set signatures (e.g., P. 61, 2nd Para - … along with each instruction is kept its minimal distance from the first instruction of the region … by looking at the minimal distance of a trace start point and the lowest minimal distance on the worklist … to make a conservative decision ...); and
- identifying a recurring working set when the relative signature distance between the current working set signature and one of the previous working set signatures

is within a predetermined threshold (e.g., P. 16, 2nd Para - … If the counter's value is above some threshold the branch is predicted taken …)

25. **As to claim 20** (Original) (incorporating the rejection in claim 19), Jacobson discloses the computerized method further comprising identifying a new working set when the relative signature distance between the current working set signature the one or more previous working set signatures exceeds a predetermined threshold (e.g., P. 16, 2nd Para - … If the counter's value is above some threshold the branch is predicted taken …)

26. **As to claim 21** (Original) (incorporating the rejection in claim 20), Jacobson discloses the computerized method further comprising maintaining a table of the one or more previous working set signatures (e.g., P. 16, 2nd Para - … a Pattern History Table (PHT) …)

27. **As to claim 22** (Original), Jacobson discloses a hardware reconfiguration method comprising:

- maintaining a table comprising a plurality of working set signatures for a program (e.g., ., P. 168, Fig. 5-3 Example global history branch predictor, elements of 'Table of 2-bit counters'; 'Current Branch PC'; P. 167, last Para - … built around <u>a table of 2-bit counters</u> …; P. 165, Sec. 5.2.1.1, Lines 8-14; Sec. 5.3.1 - Corrected Predictor; Sec. 5.3.2 – Hybrid Predictor);

- upon detecting a working set change, looking up a working set signature for a current working set in the table (e.g., P. 174, 1st full Para - The larger counter is used to enable the detection of very consistent behavior …);
- if the working set signature is in the table, reinstating a hardware configuration for the current working set; and
- if the working set signature is not in the table; identifying a new hardware configuration for the current working set and saving the working set signature and the new hardware configuration (e.g., P. 16, 2nd Para - … predict the outcome of branches based on previous branch behavior … a Pattern History Table … containing two-bit saturating counter …; Abstract, 4th Para - … takes advantage of the trace cache to dynamically optimize applications … take advantage of implementation-specific hardware …;)

28. **As to claim 23** (Original) (incorporating the rejection in claim 22), Jacobson discloses the method wherein the working set change indicates a phase change (e.g., P. 16, 2nd Para - … predict the outcome of branches based on previous branch behavior … a Pattern History Table … containing two-bit saturating counter …)

Conclusion

29. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ben C. Wang whose telephone number is 571-270-

1240. The examiner can normally be reached on Monday - Friday, 8:00 a.m. - 5:00 p.m., EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tuan Q. Dam can be reached on 571-272-3695. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Ben C Wang/
Examiner, Art Unit 2192

/Tuan Q. Dam/
Supervisory Patent Examiner, Art Unit 2192